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No. XI.

PREVENTION OF EXPLOSION IN STEAM-
ENGINE BOILERS.

The Thanks of the Society were presented to Mr. R. M'EWEN for the following Communication, as an Appendix to his Paper published in the first part of the present volume.

SINCE the publication of Mr. M'Ewen's paper in the first part of this volume, he has forwarded to the Society complete working drawings and description of his Mercurial Steam-Gauge as improved according to the results of his later experience. They contain some additions that he recommends, and are deposited in the Society's Repository for the use of those who wish to adopt them. Mr. M'Ewen also desires the following correction of the last sentence in the description of his gauge.*

GENTLEMEN, *High Mark, near Stranraer,*
17th December, 1841.

I BEG leave to bring again before your notice the prevention of accidents occasioned by steam-boilers, more particularly in reference to the steam-gauge I submitted to the notice of your Society two years ago, and to which I now wish to draw your attention in reference to some improvements I have effected in its construction, and the consideration of certain parts of the description given of it in the Society's *Transactions*.

From the last paragraph in the description of my mercurial steam-gauge, it would appear that the safety afforded by the steam-gauge depends on having the dome made of a lighter material than the boiler, that in case of the pipe G being intentionally plugged, the dome would burst and give warning of undue pressure. Instead of which, my aim, in addition to a more correct method of measuring the pressure of steam, was to construct an apparatus that would be a *complete check on the engineer, and render it impossible for him to raise the steam above a certain pressure without being detected; for the power of detection is the only real check against wilful mischief*; for no piece of machinery can be made so simple or substantial that it may not be deranged or destroyed, and whatever sort of apparatus may be attached to a steam-boiler, to prevent an excess of pressure, *must admit of having a hole or vent* to allow the extra steam to escape; and no hole or vent can be made that it is not possible to close up. Therefore any apparatus for the purpose of insuring safety would be worse than useless if it did not at all times admit of being examined and tried by any person to prove whether or not it was in proper condition; and I trust, on examination of the accompanying plans, you will be satisfied that the safe mercurial steam-gauge cannot be gagged or deranged in any manner beyond the power of detection; and, from the nature of the material used to measure the pressure of steam, viz. a column of mercury, and the simplicity of the apparatus that contains it, there cannot be a doubt of the accuracy and self-action of the apparatus.

Description.

Fig. 1 is a side representation of the gauge drawn full size, having tubes of length sufficient to contain a

column of mercury that will balance a pressure of steam of about three pounds per square inch on the boiler.

Figs. 2 and 3 shew a longitudinal and cross section of fig. 1.

The cups *A B* are of a size sufficient to contain as much mercury below the junction of the branch pipes *C D* as will at least fill one of the tubes *E*. The openings in the three-way cock are each equal to the area of the steam-pipe *F*; and it will be evident on inspection or measurement of the plug *G* in the cross section, that before the steam is shut off from either of the mercury cups it has a considerable opening to the other cup. The small pipe *H* having a stop cock in it forms a communication at the bottom between the mercury cups; and the pipe *K*, having two side openings for the escape of steam, forms a communication between the top of the mercury tubes. The small hole or opening in the tubes, on a level with the bottom of the dome, permits the mercury that may be discharged into the dome to fall again into the cups, and the length of the tubes is, of course, measured from the small holes, as the mercury will overflow when it is forced up to them. There is also a recess or hollow in the dome round the tubes at the small holes which serves as a reservoir, and prevents the breathing of the steam (particularly in engines that work expansively) from expelling the mercury before the steam has reached the limit of pressure.

Operation.

Suppose the gauge to be placed on the top of the steam-chest of a steam-boat boiler, which generally rises to the level of or above the deck; or it may be placed in any other convenient part of the vessel, and connected with the boiler by a pipe. Let a quantity of mercury be

poured into the dome, at least as much as will fill one of the tubes *B*; and, should the mercury run down both tubes, when the steam rises it will displace the mercury from the cup it has access to, and the other cup will be charged; then admit the steam to the cup that contains the mercury, and the gauge is in action; and so long as the pressure of steam is below the proper limit the gauge will remain quiet, but should the safety-valve be overloaded, or any impediment cause a pressure greater than the weight of mercury in the gauge can resist, the mercury will then be driven up into the dome and fall down into the other cup, and the steam will rush out and give the alarm, and thereby direct the attention of the engineer and all on board to the safety-valve, and the plug *G* has only to be turned round to stop off the steam from the empty cup, thereby admitting it to press again on the mercury.

*Method of detecting wilful injury or derangement of
the Gauge.*

As the steam-pipe *F* and the pipe *M* are common to both the mercury tubes, let the cock be turned to admit steam to the empty cup, and it will blow through it, thereby shewing *there is a free communication on that side of the gauge* between the steam in the boiler and the atmosphere. Turn the steam again into the cup containing the mercury, and open the small cock in the bottom connecting pipe, and the mercury will flow through that channel into the empty cup, and the steam will rush out *through the tube formerly occupied by the mercury*, thereby proving *the gauge is free from obstruction* (the mercury excepted) *in all its passages*; and the engineer should, at the request of a passenger, shew that the gauge was in order. And if

it were made a crime to overload or obstruct the free action of safety-valves, no engineer or steam-boat proprietor would attempt it when such an apparatus would immediately give notice of the circumstance. The steam-gauge in the Society's repository differs from the accompanying drawing, by having a smaller dome and wanting the connecting pipe between the top of the mercury tubes (which I considered as the cause of small particles of mercury having been carried out with the steam *in some* of the experiments I made with it at Mr. Fairbairn's works); and it also wants the communication between the bottom of the mercury cups for transferring the mercury from the one cup to the other, which I reckon an important improvement, as a person is thereby enabled to blow the steam *through all the passages of the gauge*, and prove that it is free from obstruction and in working order.

Figs. 4 to 7 shew a more simple and less expensive method of constructing the gauge, being also better adapted for making it on a larger scale than the method shewn by fig. 1. The two mercury cups are cast in one piece, having a hole drilled through the division between them and a stop cock placed in it, which serves the same purpose as the connecting pipe *h* in fig. 1; and, instead of having a three-way cock to transfer the steam, it is done by a slide valve, which opens one port and shuts the other, the same as on a steam-engine cylinder, and the valve is moved by a toothed rack and pinion connected with a handle.

Figs. 8 and 9 shew a method of construction suitable for a low pressure, and with wide pipes which are cast in form of a syphon, and having the flange *D* attached, thereby diminishing the number of parts, and rendering the apparatus more compact and economical in its con-

struction. Other methods of construction could be shewn, but those I have given will, I trust, be sufficient to explain the general method of constructing the gauge. It could also be made self-acting so far as regards the shifting of the cock or valve when the steam was blowing off, but that would to a certain extent defeat the object for which the gauge is intended, viz. to make the engineer careful, to keep the steam below the limit of pressure; knowing that when that is exceeded, the gauge will give notice of the circumstance, and the engineer or an attendant will require to shift the cock or valve by their own hand; but where the gauge is intended, by having wide tubes, to act the part of a safety valve, it might then be necessary to make it self-acting in order to prevent an unnecessary waste of steam. I may state that the mercurial steam-gauge is of no avail in giving notice of or preventing accidents arising from a deficiency of water in the boiler, for in that case, explosion may take place below the ordinary pressure owing to the flues being overheated, and being thereby unable to resist the usual pressure, or the flow of water over the hot plates will create a sudden generation of steam which no safety-valve could afford timely escape for. In my letter to the Secretary of the Society, the water apparatus was alluded to as the means of preventing explosion from excess of steam or *deficiency of water*,* and I have lately simplified and improved its construction, so that it can be tested as to its condition in the same way as the mercury-gauge, thereby affording *a complete check on the engineer in the management of both steam and water*; and if the prevention of accidents

* The apparatus here alluded to acts on the same principle as the mercurial gauge, the water being forced by the pressure of the steam into a stand-pipe connected with the boiler.

occasioned by steam-boilers be a subject worthy of prosecuting, my plans are ready to be put in practice whenever an opportunity may offer that holds out a prospect of remuneration for my trouble ; and I leave the matter in the hands of the Society, confident from previous experience, that they will render every attention and assistance in furthering it ; and should your Committee, from my imperfect description, be at a loss in comprehending any part of the accompanying drawings, I shall be happy to afford what further information may be necessary.

I am, Gentlemen, &c. &c.

*To the Committee of Mechanics,
Society of Arts, &c.*

ROBERT M'EWEN.